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FIPS
FEDERAL INFORMATION PROCESSING STANDARDS

OBJECTIVES
AND REQUIREMENTS
OF THE
FEDERAL INFORMATION
PROCESSING STANDARDS
PROGRAM

Foreword

The Federal Information Processing Standards Publication Series of the National Bureau of Standards is the official publication relating to standards adopted and promulgated under the provisions of Public Law 89-306, and under Office of Management and Budget Circular A-86. The entire series constitutes the FEDERAL INFORMATION PROCESSING STANDARDS REGISTER.

This series is used to announce Federal Information Processing Standards, and to provide standards information of general interest and an index of relevant standards publications and specifications. Publications that announce adoption of standards provide the necessary policy, administrative, and guidance information for effective standards implementation and use. The technical specifications of the standard are usually attached to the publication, otherwise a source of copies is cited.

Comments covering Federal Information Processing Standards and Publications are welcomed, and should be addressed to the National Bureau of Standards, Institute for Computer Sciences and Technology, Office of Information Processing Standards, Washington, D.C. 20234. Such comments will be either considered by NBS or forwarded to the responsible activity as appropriate.

LAWRENCE M. KUSHNER, *Acting Director*

Abstract

Public Law 89-306 (the Brooks legislation) was enacted to provide for the economic and efficient purchase, lease, maintenance, operation and utilization of automatic data processing equipment by Federal departments and agencies. Among the other provisions of PL 89-306, the Secretary of Commerce is authorized to make appropriate recommendations to the President relating to the establishment of uniform Federal automatic data processing standards. The Federal Information Processing Standards Program was established in response to this part of the legislation. The purpose of this document is to outline the objectives of the Federal Information Processing Standards Program and to identify requirements for specific standards necessary to accomplish these objectives.

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OBJECTIVES AND REQUIREMENTS
OF THE
FEDERAL INFORMATION PROCESSING STANDARDS PROGRAM

Federal Information Processing Standards Publications are issued by the National Bureau of Standards under the direction of the Office of Management and Budget in accordance with the provisions of Public Law 89–306 and Office of Management and Budget Circular No. A–86.

I. Introduction

Public Law 89-306 (the Brooks legislation) was enacted to provide for the economic and efficient purchase, lease, maintenance, operation and utilization of automatic data processing equipment by Federal departments and agencies. Among the other provisions of PL 89-306, the Secretary of Commerce is authorized to make appropriate recommendations to the President relating to the establishment of uniform Federal automatic data processing standards. The Federal Information Processing Standards Program was established in response to this part of the legislation. The purpose of this document is to outline the objectives of the Federal Information Processing Standards Program and related standards activities and to identify requirements for specific standards to accomplish these objectives.[1]

This document deals, for the most part, with the Department of Commerce responsibility for recommending uniform automatic data processing standards to the President of the United States.[2] It is recognized, however, that some requirements that are included fall outside the scope of the FIPS Program. For example, those dealing with the acquisition and reassignment of ADP products and services are the responsibility of the General Services Administration. In these cases, the National Bureau of Standards will provide technical guidance and assistance, but the actual development and promulgation of standards or guidelines will be carried out by the General Services Administration. Such requirements are included in this document to illustrate the need for this type of guidance in satisfying the overall objectives of PL 89-306.

It is further recognized that some standards, especially those involving data communications, are the mutual responsibility of the National Bureau of Standards under the FIPS Program (Public Law 89-306) and the Executive Agent, National Communications System under the Federal Standards Program (Federal Property Management Regulation 101-29). The exclusive and mutual responsibilities of the National Communications System and the National Bureau of Standards in these related efforts are delineated in the Appendix to this FIPS PUB.[3]

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[1] The objectives and requirements included in this FIPS PUB were approved by the Office of Management and Budget on November 13, 1972.

[2] On June 17, 1971, the authority for the approval of Federal Information Processing Standards was delegated by the President to the Director of the Office of Management and Budget.

[3] On June 22, 1972, the Director, Office of Telecommunications Policy, Executive Office of the President identified the Executive Agent, NCS, as the focal point to prepare recommended standards for the interoperability of the NCS networks and to assure an effective interface between computers and communications systems consistent with the responsibility delineated in this Appendix. Also on this date, he requested that the Executive Agent, NCS accordingly be designated the responsible agent under the Federal Standards Program. This designation was made by the Acting Administrator, General Services Administration on August 14, 1972.

II. Background

The Federal Government is the largest single user of information processing equipment. Since the introduction of the first general purpose computer in 1951, use has increased to where there were approximately 6478 computers in the Federal Government on June 30, 1972. The establishment of information processing standards was not recognized as a significant factor in the early years of government computer use since there were only a small number of manufacturers and a limited selection of available equipment. Information systems were generally self-contained and those standards that were established were done so on strictly a local basis. However, as the technology advanced and as the number of applications of information processing systems increased, the need for standardization became more apparent. Large systems now being acquired by the Government include complex networks of peripheral devices and central processing units and frequently these interface with extensive systems of world-wide telecommunications.

A practice used by some agencies in the past in acquiring multiple computer systems has been to procure these from a single supplier. Acquisitions of this type provide a certain amount of standardization and compatability within a given environment. In many cases the supplier provided nearly all the system components including communications hardware. However, this type of "single vendor" procurement did not provide compatibility with other systems acquired from other suppliers. Furthermore, this approach to achieving standardization by procuring equipment and services from a single supplier resulted in unbalanced competition.

To utilize computer technology most effectively, it is desirable, to the extent feasible, to establish standards that are designed to achieve the maximum degree of compatibility and interchangeability among systems. Federal agencies would be required to implement and comply with the standards unless otherwise justified. This approach has far reaching and lasting benefits. From a management standpoint, the interchangeability of equipment, programs and data throughout the entire Federal establishment would extend the efficiency and usefulness of Federal systems, facilitate their orderly replacement as required, and reduce their overall cost.

III. Program Objectives

The objectives of the standardization program are categorized according to six major areas of concern, as follows:

A. DATA, PROGRAMS AND COMPONENTS
1. To facilitate the interchange of machine sensible data within and among data processing installations.
2. To facilitate the interchange of computer programs among computers of different makes and models.
3. To facilitate the interchange of computer components and devices across product lines.

B. DATA COMMUNICATIONS
1. To establish, where applicable, common and uniform standards for both information processing and data communications.
2. To facilitate the interfacing of information processing and data communications systems.

C. COMPUTER PERFORMANCE
1. To provide objective measures of performance for Federal computing systems, components and software packages.

D. APPLICATIONS AND DATA
1. To eliminate continued duplicate development of like computer applications throughout Government departments and agencies.
2. To facilitate the interchange of data at the data element level.

E. PERSONNEL AND ENVIRONMENT

1. To maximize the productivity of technical personnel working with Federal information processing systems.
2. To reduce the need for retraining in programming, operations and maintenance due to differences in manufacturers' products and systems.
3. To develop guidelines for ADP and telecommunications site preparation and environment.

F. ACQUISITION AND REASSIGNMENT OF ADP PRODUCTS

1. To provide tools for optimizing computer selection.
2. To facilitate and speed-up the mechanics of acquiring information processing systems, components, software and related material, supplies and services.
3. To protect current investments in computer programs, data files and personnel when acquiring new equipment.
4. To stimulate competition and facilitate the procurement of portions of multiple CPU computer systems from different suppliers.
5. To stimulate competition and facilitate the procurement of components of a single CPU system, particularly peripheral devices, from different suppliers.

To achieve these objectives, the program must progress in a systematic timely manner. Standards cannot be established on an ad hoc basis but must be properly coordinated to assure consistency among individual standards. Priorities need be given those standardization development efforts having the most need and potential benefits. Implementation of standards must be planned and phased in a realistic manner to minimize disruption and costs.

IV. Standards Requirements

It is recognized that the specific requirements for standards will change over time as information processing technology develops. Thus, it will be necessary that they be revised from time to time. Further, the requirements listed here are not complete even for the current instant of time. In general, the individual standards requirements listed for each objective are necessary. They may or may not be sufficient in themselves to realize the objectives in full.

In order to indicate the relationship between requirements and objectives in the following listing, the objectives are repeated. Some requirements relate to more than one objective. Where this is the case, the requirement is cross referenced rather than repeated. Some requirements, particularly in section F.2.a.(1)-(7) below, are of the type that should be met by guidelines rather than standards. Where this is the case, the word "guideline" is used in the statement of the requirement.

A. DATA, PROGRAMS AND COMPONENTS

1. To facilitate the interchange of machine sensible data within and among data processing installations.

   a. *Character sets, codes and related topics*

      (1) Seven-bit code for information interchange.
      (2) Subsets of the seven-bit code for information interchange.
      (3) Eight-bit code for information interchange.
      (4) Registration of expanded and extended codes for particular application areas.
      (5) Structuring of data files.

b. *Media*
(1) Unrecorded and recorded magnetic tape.
(2) Unrecorded and recorded magnetic disks and disk packs.
(3) Reference tapes and disks and measuring techniques for evaluating manufacturer's products and calibrating read/record equipment.
(4) Formats for magnetic tape and disk labels.
(5) Punched cards including card quality and dimensions, locations of holes and data representation.
(6) Perforated tape and reels including tape quality and dimensions, locations of holes and data representations.
(7) Unrecorded and recorded magnetic tape cassettes.
(8) Reference tapes and measuring techniques of magnetic tape cassettes.

c. *Character Recognition*
Optical character recognition standards to include upper and lower case font or fonts, print quality, layout of forms, and other related items.

2. To facilitate the interchange of computer programs among computers of different makes and models.

a. *Programming Languages*
(1) Programming language standards for those languages in common use such as COBOL and FORTRAN.
(2) Standard levels for compilers.
(3) Decision tables.
(4) Data descriptive language.
(5) Program overlay procedures.

b. *Operating Systems*
(1) Standards for interfacing operating systems, compilers and application programs.

c. *Data Management Systems*
(1) Standards for data management systems to include data description, file creation, query language and output presentation.

3. To facilitate the interchange of computer components and devices across product lines.

a. *Interface Standards*
(1) Standards for electrical, mechanical and logical interface between the central processing unit and input/output peripheral devices, including magnetic tape drives, magnetic disk drives, perforated tape drives, punched card equipments and display devices.
(2) Standards for the electrical, mechanical and logical interface between information processing systems and telecommunications systems.

B. DATA COMMUNICATIONS

1. To establish, where applicable, common and uniform standards for both information processing and data communications.

a. *Interchange Codes*
(1) Same as A.1.a.

b. *Character Structures and Formats*
(1) Bit sequencing in serial-by-bit data transmission.
(2) Character structure and character parity sense for serial-by-bit data communication.
(3) Character structure and character parity sense for parallel-by-bit data communication.

    c. *Operating Procedures*
       (1) Formats and procedures for:
- Code dependent links and systems.
- Code independent links and systems.
- Communication with time share l computer systems.

       (2) Error detection and correction.
  2. To facilitate the interfacing of information processing and data communications systems.
    a. *Interface Standards*
       (1) Signal quality at interface between information processing terminal equipment and synchronous data communication equipment for serial data transmission.
       (2) Synchronous signaling rates for data transmission.
       (3) Interface between data terminal equipment and data communications equipment employing serial binary data interchange.
       (4) Interface between data terminal equipment and automatic calling equipment for data communications equipment.
    b. *Data Communications Link and Systems Performance*

C. COMPUTER PERFORMANCE

  1. To provide objective measures of performance for Federal computing systems, components and software packages.
    a. *Benchmark programs*
    b. *Computer performance simulators*
    c. *Computer performance monitors*
       (1) Hardware.
       (2) Software.
    d. *Analytic evaluation techniques*

D. APPLICATIONS AND DATA

  1. To eliminate continued duplicate development of like computer applications throughout the Government departments and agencies.
    a. *Classification*
    Classification of common computer applications and their variations.
    b. *Application Standards*
       (1) Program packages for common applications such as payroll, budgeting, personnel management, and telecommunications to eliminate recreating, documenting and maintaining the same programs in the various Federal agencies.
       (2) Utility programs such as sorts, merges, automatic flowcharting, machine utilization accounting, etc.
       (3) Network-oriented information systems such as PERT and CPM.
  2. To facilitate the interchange of data at the data element level.
    a. *Data Standards*
       (1) Data elements, codes, and record formats for data commonly interchanged among agencies.
       (2) Methods (other than programming languages) for specifying data formats and the data contained therein.
       (3) Procedures and guidelines for standardizing data for use by the Federal agencies.

E. MANAGEMENT, PERSONNEL AND ENVIRONMENT

  1. To maximize the productivity of technical personnel working with Federal information processing systems.
    a. *Documentation*
       (1) Documentation standards for describing information processing and telecommunications systems to include flowcharting, program logic, operations manuals, and general system descriptions.
       (2) Hand printed characters.
       (3) Vocabulary of terms and definitions to be used in describing information processing and telecommunications systems and related fields.
       (4) Standards for describing data interchange formats.

    b. *Man-machine Interface*
       (1) Operating system control language.
       (2) User procedures for interactive remote terminals.
          • typewriter-like, including displays.
          • touchtone input-audio response with optional visual and/or hard copy.

2. To reduce the need for retraining in programming, operations and maintenance due to manufacturers' products and systems.

    a. *Keyboards*
    Keyboard arrangements for data preparation and data communications terminal devices.
    b. All of A2, B1, D1, D2.

3. To develop guidelines for ADP and Telecommunications site preparation and environment.

    a. *Environmental Standards*
       (1) Standards or guidelines for ADP and telecommunications site preparation and environment.
       (2) Electrical safety for data processing equipment.

    b. *Operating Procedures*
    Procedures for machine utilization accounting.

F. ACQUISITION AND REASSIGNMENT OF ADP PRODUCTS

1. To provide tools for optimizing computer selection.
    a. Same as C.
    b. To catalog, validate and evaluate computer components, software packages and other ADP products and services for use in Federal ADP procurements.

2. To facilitate the speed up of mechanics of acquiring information processing systems components, software and related material, supplies and services.

    a. *Selection and Procurement*
       (1) An outline and format for formulating procurement solicitations. This will include methods for describing processing requirements, current and projected workloads and mandatory hardware/software features.
       (2) A guideline for evaluating manufacturers' proposals.
       (3) A guideline for the selection of information processing systems. The guideline will include (as applicable) criteria, including benchmarks, for measuring the overall systems performance.
       (4) A guideline for the separate acquisition (other than Original Equipment Manufacturers—OEM) of systems software including compilers, diagnostics, other general utility programs, and associated services.
       (5) Standard criteria for measuring the performance of software.
       (6) Standard criteria for measuring the performance of hardware components.
       (7) A guideline for the separate acquisition (other than OEM) of hardware components including peripheral devices.

3. To protect current investments in computer programs, data files and personnel when acquiring new equipment.
    a. Standards listed in A1, A2 and D1, D2.

4. To stimulate competition and facilitate the procurement of portions of multiple CPU computer systems from different suppliers.
    a. A1, A3.

5. To stimulate competition and facilitate the procurement of components of a single CPU system, particularly peripheral devices, from different suppliers.
    a. F.2.a.(7).

V. Relationship to ANSI and ISO Standards

It is recognized that information processing standards are being developed nationally under the auspices of the American National Standards Institute (ANSI) and internationally under the auspices of the International Organization for Standardization (ISO). It is important that Federal computers and information systems be compatible not only with each other, but also with those of State and local governments, the private sector of the economy and those of other nations. Accordingly, standards developed to meet Federal requirements should, to the extent practicable, be consistent with corresponding ANSI and ISO standards.

In order that Federal interests be adequately reflected in such standards, Federal participation in their development is encouraged and actively supported. This should not necessarily prevent the Government from (1) adopting standards on its own in cases where ANSI and ISO standards do not exist or are inadequate, nor from (2) modifying ANSI and ISO standards where they do not satisfactorily meet Federal requirements, nor from (3) embarking on independent standards development efforts in cases where ANSI and ISO efforts do not exist, or are too slow, or are leading to results which will not satisfy the Government's needs.

Appendix

EXCLUSIVE AND MUTUAL RESPONSIBILITIES OF THE NATIONAL COMMUNICATIONS SYSTEM AND THE NATIONAL BUREAU OF STANDARDS FOR THE DEVELOPMENT OF FEDERAL STANDARDS RELATED TO DATA TRANSMISSION AND TELEPROCESSING

General

For the purposes of this paper, NCS is taken to mean the Offices of the Manager of the National Communications System. NBS is taken to mean the Institute for Computer Sciences and Technology of the National Bureau of Standards. Teleprocessing is taken to mean automated data processing which makes direct use of data transmission via switched or long distance non-switched telecommunication facilities.

The delineations of responsibilities presented below are adapted from, and correspond to the division of responsibilities laid out in ITU-CCITT Recommendation A-20, affecting the responsibilities of the International Telecommunications Union and the International Organization for Standardization and the International Electrotechnical Commission. The international aspects are analogous to the relationships between the existing Federal Information Processing Standards (FIPS) Program and the Federal Telecommunication Standards Program.

Exclusive Responsibilities

NBS—Teleprocessing

Pursuant to P.L. 89-306, the National Bureau of Standards (NBS) currently is responsible for recommending uniform Federal automatic data processing standards. This responsibility is fulfilled through the Federal Information Processing Standards (FIPS) Program and encompasses Federal standards related to automated data processing equipment, techniques, and computer languages; the provision of technical advice and assistance with respect to standards for data elements and codes and maintaining appropriate Registers and Reference files therefor. The NBS is also responsible for the guidance and monitorship of programs to promote the development and testing of voluntary commercial standards for ADP equipment, techniques, and computer languages, and for recommending procedures to be used in the Federal Government for adopting Federal standards and developing and implementing plans therefor.

NCS—Data Transmission

It will be the responsibility of the National Communications System (NCS) to recommend uniform Federal standards for transmission and switching employed in telecommunication networks used for data transmission. This responsibility will be fulfilled through a Federal Telecommunication Standards Program, and will encompass Federal standards related to transmission and switching equipment and techniques, and to equipment and techniques pertaining to modulation conversion for transmission. The NCS will also be responsible for the specification of any necessary Federal standard for manual or automatic operation procedures for the setting up, holding, and clearing of calls for data transmission within Federal multi-purpose switched networks.

Mutual Responsibilities

The development of Federal standards for the junction (interface) between terminal modem and data terminal equipments shall be as agreed between the NCS and the NBS.

The development of Federal standards relating to alphabets and characters [1] used for teleprocessing purposes shall be as agreed between the NBS and the NCS.

Devices designed to detect and/or correct errors must account for the following factors: (i) the error rates tolerable to the user; (ii) the line transmission conditions; and (iii) the error detection codes which must cope with the exigencies of the data alphabet and characters, as well as with error control and requisite signalling.

In this regard: Federal standards relating to limits for tolerable error rates for teleprocessing purposes shall be the responsibility of the NBS; Federal standards relating to limits for line transmission conditions for data transmission purposes shall be the responsibility of the NCS; and Federal standards relating to the error detection codes and requisite signalling shall be as agreed between NCS and NBS.

Coding [2] is a field which cannot be decided unilaterally because of possible restrictions to teleprocessing which transmission and switching peculiarities may impose. The NCS with assistance from the NBS shall undertake any requisite standardization with respect to Federal multi-purpose switched networks which are used for data communications and which may be subject to such restrictions. Federal standards relating to limits of transmission path performance including modems shall be the responsibility of the NCS. Federal standards relating to limits for the transmission performance and signal margin requirements of transmitting and receiving terminal data equipment shall be the responsibility of the NBS. The limits which would apply in respect to either of the above types of standards shall be determined by agreement between NBS and NCS.

The NCS and the NBS shall cooperate in the development of Federal standards requisite to the effective utilization of new technological developments in the Telecommunication and Computer fields so as to optimize data transmission capabilities in support of teleprocessing activities.

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[1] The ITU List of Definitions No. 31.08, "A table of correspondence between the written characters together with some of the functions and the data signals which represent them." By way of example, the International Alphabet No. 5 (in the U.S., the ASCII) developed jointly by the CCITT and the ISO for general (but not exclusive) use for data and message transmission, and was standardized as a common alphabet by the two organizations.

[2] A system of rules and conventions according to which the signals corresponding to a text should be formed, received and translated—ITU List of Definitions No. 31.07—hence a transformation of the format of the signals in the alphabet for taking account of synchronous methods, and introduction of redundancy in accordance with the error control system.

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